

INDICATIONS AND COMPLICATIONS OF CENTRAL VENOUS CATHETERIZATION IN CRITICALLY ILL CHILDREN IN INTENSIVE CARE UNIT

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ABSTRACT

Background: Nothing can be more difficult, time consuming and frustrating than obtaining vascular access in critically ill pediatric patient¹. Central venous catheters are widely used in the care of critically ill patients.

Methodology: This paper reviews our experience with central lines in 28 critically ill patients including neonates and non-neonates, in a study period of October 2008 to October 2009. Of the total 28 patients, central venous catheterizations was more in those who were more than a month age and of female sex.

Results: The route of insertion was femoral in approximately 89% of our patients and insertion was successful in 24 patients. The most common indication we observed for catheter use was, venous access in shock (37.1%) in neonates and for monitoring the central venous pressure (32%) in non neonate patients of ARDS with pulmonary edema and Shock. The central line was removed in majority of patients (60%) within 24-48hrs of insertion and was kept for maximum of six days in just one patient. Organism most frequently isolated was Acinetobacter. Recommendations made include, use strict aseptic measures by restricted number of skilled operators while inserting and during maintaining central line, routine confirmatory x-ray or fluoroscopy to check the position of central line before catheter use, if possible, use for central pressure monitoring recommended.

Conclusion: We concluded that central venous catheterization is a safe and effective measure so we recommend timely and judicious use of percutaneous central venous catheter in paediatric critically ill patients of PICU and NICU.

Keywords: Central Venous Catheterizations, Indications, Complications, PICU and NICU

INTRODUCTION

Nothing can be more difficult, time consuming and frustrating than obtaining vascular access in a critically ill pediatric patient. This was best described by Orłowski in 1984, who stated, 'My kingdom for an intravenous line'¹. This article reviews the various indications, sites, techniques and complications that may occur during acute intravascular access by CVC in emergency situations or in intensive care settings. Following the introduction and widespread use of central venous catheters (CVCs) in adult patients, these devices are now frequently used also in the pediatric population. They have become an indispensable route for venous access, especially in pediatric and neonatal intensive care units. Nowadays, millions of CVCs are used worldwide, so central venous line insertion is one of most frequently performed procedure in critically ill neonates and non neonates for poor venous access

,volume resuscitation, CVP monitoring, administration of medication, total parenteral nutrition and cardiopulmonary resuscitation². In recent years, a number of reviews have been published dealing with complications of CVC use in the adult population. However, specific problems associated with central venous access in pediatric patients were not addressed in these articles, and indeed problems in pediatric patients were often explicitly excluded. Percutaneous central venous catheterization reduces the need for the stress of repeated venepuncture and also saves the vein for future use, which is not the case if venous access is achieved using the cut-down technique. The widespread use of central venous catheters during the last few years has been reported to be associated with many complications, some of them lethal³. This paper audits our Indications, techniques and various complications noted during the procedure of

percutaneous central venous catheterization at a tertiary referral center.

OBJECTIVES

The study was conducted to study indications of central venous line insertion and complication associated with central line with special reference to catheter related blood stream infection.

MATERIAL AND METHODS

It was a Prospective study conducted in Neonatal Intensive Care Unit (NICU) and Pediatric Intensive Care Unit (PICU) of SSG Hospital Vadodara, a tertiary care level hospital and teaching institute. The study was conducted during October 2008 to October 2009.

A total of 28 children required central line insertion during study period .All patient below the age of 12 year having requirement of insertion of central line were included in the study . Exclusion criteria were patients with bleeding disorder, on anticoagulation therapy with distorted anatomy, burns at insertion site and severe dermatitis at insertion site. All lines were inserted by a single person (resident in the Department of Pediatric) using the Seldinger technique by a uniform protocol initially under supervision and later independently by the bedside. Each catheterization was followed by an X-ray to confirm the position of the tip of the catheter. Each skin puncture was defined as an attempt. Success was defined as the ability to cannulate the vein. Data collected included age, weight, sex, hemodynamic status, indication for placement, site of catheterization, number of attempts and immediate complications. Then patients were followed for immediate complications like catheter malposition, arterial puncture, bleeding, unable to insert, catheter displacement and late complications like infectious, local, vascular and mechanical.

Data was recorded using a predesigned semi structured proforma and entered into Microsoft Excel worksheet. Appropriate tests were applied for analysis.

RESULT AND DISCUSSION

Sir Sayajirao Gaekwad Hospital a tertiary level referral teaching hospital, Vadodara, has three main intensive care units under Department of Pediatrics - Intramural NICU, Extramural NICU and PICU. As a referral hospital, it receives admissions not only from Gujarat but also from various neighboring states, accounting for sizeable neonatal and pediatric admissions. The prospective study was conducted from October 2008 to October 2009 at Intramural (for in born babies), Extramural (for out born babies) Neonatal Intensive Care Unit (NICU) and Pediatric Intensive Care Unit (PICU) of Sir Sayajirao Gaekwad (SSG) Hospital.

The observation of age of patients is comparable with the Signa vitae study⁴. Male: female ratio is 0.64. The difference observed probably is due to gender bias seen

in form of late referral of female child by parents to hospital, bringing them in critical stage, requiring central line insertion.

Table 1: The profile of the patients compared with other studies

	Current study	CMC Ludhiana ³	Signa vitae ⁴
Age of patients			
Neonates (< 28 days)	39.2	63	42.9
Non neonate (1 month – 12 yrs)	60.7	37	57.1
Sex			
Male	39.2	83.5	
Female	60.7	16.5	

All figures are in percentage

Out of the 28 critical patients following are the various indications for inserting central line:

The most common indication for which central line was inserted is poor venous access which is comparable with the study conducted Dr Geetika Dheer and colleagues of CMC Ludhiana³. Other common indications were for CVP monitoring, volume resuscitation ,CPR resuscitation and for medication.

Table 2: Comparison of Indications of CVC

	Current Study	Geetika ³
CVP Monitoring	8	2
Poor Venous Access	13	70
Volume Resuscitation	11	-
Prolonged Venous Access required	-	22
Total Parenteral Nutrition	1	9
Cardio-pulmonary Resuscitation	1	-
Medications	1	-

Most of the CVP lines were inserted in two attempts followed by single attempts. Three attempts were usually required in those who were in shock. In most of the patients central line was kept for 24 hours.

Table 3: Comparison of success rate of CVP line insertion in various studies

Name of study	Success Rate (%)
Our study	92.3
B karapinar and colleague ⁵	92.4
Geetika Dheer and colleague ³	92.9

The most common route of insertion selected was femoral route (89%) which is comparable with the study of Bulent karapinar⁵ and colleague who had used femoral vein in 45% patients. In our study femoral route is followed by internal jugular (7.1%) and Axillary (3.5%). Successful catheter insertion was possible in

92.3% which is comparable with the study Dr Bulent karapinar⁵ the success rate were 92.4% and we were not able to insert catheter in 7.6% patients.

In our study complications were observed in 28% patients whereas no complications were observed in 72% of patients, thereby making it safe in all critically ill patients.

Table 4: Complications CVC observed in various studies

	Our study	Study of karapinar & colleagues ⁵	Signa Vitae Study ⁴	Study of Chua MC, Chan IL ⁶	Study of Rao & colleagues ⁷
No complications	72	-	44	42	-
Malposition	7	7.3	19	-	-
Bleeding	3	3.3	-	-	-
Arterial puncture	0	8.9	-	-	-
Catheter related infection	15	-	14	32	15.4
Extravasation	0	3.8	-	-	-
Spontaneous removal	3	3.8	13	-	-

All figures are in percentage



Fig 1: Normal position of central venous catheter



Fig 2: Bending of central line

Complications were further divided into immediate and delayed complications. In immediate complications malposition and bleeding were seen. Some of the patients had got more than one complications. In delayed complication catheter related infections were most common complication.

Table 5: Catheter related infections in the current study

Organism	Positive blood culture (%)	Positive CVC tip culture (%)
Acinetobacter	8 (30.7)	14 (19.2)
Pseudomonas	5 (19.2)	3 (11.5)
E coli	2 (7.6)	2 (7.6)
Klebsiella	2 (7.6)	1 (3.8)
Enterococcus	2 (7.6)	1 (3.8)
CONS	1 (3.8)	
Contaminated	3 (11.5)	
No organisms	3 (11.5)	14 (53.8)

Table 6: Catheter related-bloodstream infections (CRBI) of inserted CVCs in a Signa vitae study⁴

Organism	Cases
Staphylococcus aureus	1
Coagulase-negative Staphylococcus	3
Candida albicans	1
Klebsiella pneumoniae	2
Methicillin-sensitive Staphylococcus epidermidis	1
Methicillin-resistant Staphylococcus epidermidis	5
nonenteric Gram-negative rods	1
Total	14

In our study the organism most commonly isolated in both blood culture and CVC tip culture was Acinetobacter species, but the blood culture correlating with CVC Tip culture was seen in 4 patients. According to different microbiological flora in different hospitals, the organism and its antibiotic sensitivity might differ. Looking at the outcome, 60.7% of patients succumbed, was probably due to the critical condition in which they were brought. This can be supported by the fact that catheter related blood borne infection were only in 4 out of 26 patients in whom the central line was inserted.

CONCLUSION

Most common indication in neonate was poor venous access and in non-neonate was central venous pressure monitoring and poor venous access. The most common route of insertion selected was femoral route was selected due to less chances of mechanical complications, easy access, bleeding complications being easily controlled by local pressure. 28% had catheter related complications in which catheter related blood borne infection was most common and *Acinetobacter* was most commonest organism isolated.

LIMITATIONS

We are not able to check the position of catheter using fluoroscopy method, due to non availability of the appliance so we did an x-ray to look at correct position of central line.

RECOMMENDATIONS

We recommended using strict aseptic measures by restricted number of skilled operators while inserting and during maintaining central line to prevent infection. In our study 72% of patients had no complications showing that central venous catheterization is a safe and effective measure so we recommend timely and judicious use of percutaneous

central venous catheter in critically ill patients of PICU and NICU.

ABBREVIATIONS

CVC = central venous catheter; EJV = external jugular vein; IJV = internal jugular vein; IO = intraosseous

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